

## Establishing Operations and the Discriminative Stimulus

Margaret A. McDevitt and Edmund Fantino  
University of California-San Diego

Michael's paper seeks a rebirth of interest in motivation through development of the notion of establishing operations. As the fourth term to supplement the traditional three-term contingency of behavior, the notion of establishing operations provides a helpful system for identifying motivational functions affecting behavior. Michael notes that motivation is "an important topic" that "plays only a small role" (p. 191) in behavior analysis. We demur to the extent of pointing out that extensive research on response deprivation and reinforcement hierarchies seem to us to be very relevant to motivation (e.g., Bernstein & Ebbesen, 1978; Premack, 1962; Timberlake, 1980). Although Michael does not refer to this research, presumably he would identify response deprivation as an establishing operation that momentarily increases the reinforcing effectiveness of the opportunity to engage in the response. The thriving area of behavioral economics also helps to identify conditions that vary reinforcing effectiveness (e.g., see Hursh, 1991, on behavioral economics, drug abuse, and drug abuse policy). Our own interest in delay-reduction theory (DRT) caused us to consider its relation to Michael's analysis, a consideration that is also implicated in the one area of substantive disagreement we have with his presentation. But first we point out that the three areas of research we cite here share an important feature: All stress the relativity of stimuli as reinforcers or punishers depending upon context. We illustrate with a brief paragraph on DRT (Fantino, 1969; Fantino & Abarca, 1985; Fantino, Preston, & Dunn, 1993).

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Correspondence concerning this article should be addressed to either author at the Department of Psychology, 0109, University of California-San Diego, La Jolla, CA 92093.

According to DRT, the strength of a stimulus, as measured in a choice test, is determined by the correlation between that stimulus and reinforcement. Thus, a stimulus correlated with a greater reduction in time to reinforcement (or an increase in time to punishment) will be a stronger conditioned reinforcer than one correlated with a lesser reduction in time to reinforcement (or a lesser increase in time to punishment). It follows that a stimulus with a fixed relation to food reinforcement, for example, may or may not be a reinforcer, depending on the context in which it occurs. Thus, a red light associated with a fixed-interval (FI) 5-min schedule will be a conditioned reinforcer if alternated with extinction but not when alternated with an FI 1-min schedule, because only in the former case is the red light correlated with a reduction in time to reinforcement (Auge, 1974). In Michael's terms, we presume that the context would provide the establishing operation for the reinforcing potency of the red light rather than anything that occurs in the presence of the red light (which bears a fixed relation to food across conditions). We return to a similar "relativistic point" later, when discussing escape.

Michael's paper raises some interesting questions involving different types of conditioned establishing operations (CEO). For example, he asks the reader to "Imagine a rat in a procedure in which a lever press terminates the shock but a wheel turn terminates the warning stimulus and avoids the shock. [One type of] CEO would be demonstrated if the warning stimulus evoked the lever press; [another type of CEO] would be demonstrated if the warning stimulus evoked the wheel turn" (p. 202). Mowrer and Lamoreaux (1946) and Bolles (1970) have in fact reported data from comparable procedures. Their results suggest both outcomes. For example, Mowrer and Lamoreaux found that when different re-

sponses were required for avoidance and escape, rats eventually came to respond to the warning stimulus with the appropriate avoidance response but that acquisition was retarded compared to rats for which the same response was required for both escape and avoidance. They note that "even when conditions are such as to result eventually in a CR which differs markedly from the UnCR there is nevertheless a strong tendency, especially in the early stages of training, for the CR and UnCR to be alike" (Mowrer & Lameriaux, 1946, p. 45). Thus, in Michael's terms the first CEO is demonstrated early in training, the second later in training. Bolles's results show that the relative dominance of each depends importantly on the specific response selected, a point suggested by Mowrer and Lameriaux as well.

Perhaps Michael's most important contribution is the clear distinction he provides between motivational and discriminative stimulus effects. Whereas discriminative stimuli evoke responding as the result of a correlation with the availability of an effective consequence, establishing operations alter the reinforcing effectiveness of consequences while simultaneously evoking behavior that in the past has produced that consequence. However, although such an analysis sheds light on the distinction between motivational and discriminative stimulus effects on behavior, those effects overlap in terms of the evocation of behavior. Is this overlap necessary, or even desirable? For example, do variables that alter the reinforcing effectiveness of a consequence always evoke behavior relevant to that consequence? If so, what determines the nature of the behavior that is produced, when typically entire classes of responses are related to particular motivational "states"? In Michael's instructive example of a workman requesting a screwdriver from his assistant upon encountering a slotted screw, Michael identifies the sight of the screw as having two functions related to a conditioned establishing operation (CEO): First, the screw alters the momentary reinforcing effectiveness of a particular screwdriver;

second, it evokes a response, the request, that in the past has been reinforced in such circumstances. Although the first effect is clear, the second raises the issue of the stimulus control of the request. It seems reasonable to assume that if the assistant were not present, the request would not likely be made, and a response differing in topography would be emitted. Is it not more parsimonious, and, in any event, simpler conceptually to consider the slotted screw as the CEO and the assistant as the S<sup>D</sup>?

In essence, the alteration of reinforcing effectiveness is functionally distinct and unique to establishing operations, but the discriminative function is not. In most cases involving classes of responses related to a particular consequence, the evocative function of an establishing operation appears to bring us no closer to predicting the nature of the response, which is usually dependent upon additional contextual stimuli. To the contrary, the discriminative function of the establishing operation seems to have a more general effect, namely that of strengthening related S<sup>D</sup>s. Although an establishing operation may alter the reinforcing effectiveness of a consequence, it may not also be associated with the availability of that consequence until other relevant environmental stimuli are present. For example, we don't ask for a screwdriver if a listener is not present, and we don't stand in line at the grocery store if we have no money.

Michael's article offers two other types of examples that argue for the necessity of a dual role for the EO. One involves the important example of escape from or avoidance of painful stimulation, with the critical point that a painful stimulus cannot be an S<sup>D</sup> "because its absence has not been a condition in which an effective form of reinforcement was unavailable for a particular type of behavior" (p. 195). But Michael here takes a narrow view of reinforcement (as shock offset). As we noted in our opening two paragraphs, it is often limiting to view reinforcement and punishment in absolute rather than relativistic terms. The value of outcomes depends on what else is possible, and is

rarely strictly neutral. For example, by a broader, more relativistic view, the lever press is reinforced by increasing the time to (or removing) the shock in the shock condition and produces no improvement in delaying shocks or in bringing the subject closer to other reinforcing events at other times. Why then is the lever not an S<sup>D</sup> for responding in the presence of shock? The lever in the presence of shock functions as a compound stimulus that is uniquely correlated with an increase in the availability of reinforcement (shock offset) for a particular response (lever pressing). It is critical to note that neither stimulus alone—lever or shock—is sufficient to evoke lever pressing. It is the combination of these stimuli that evokes responding and serves a discriminative function.

Finally, when Michael discusses conditional conditioned reinforcement he presents an interesting example in which a buzzer is a conditioned reinforcer “but is conditional upon the color of the overhead light” (p. 204). He notes that the red overhead light is not an S<sup>D</sup> “because it is not correlated with the availability of the buzzer—the buzzer is actually available irrespective of the light condition, but it is not an effective form of reinforcement in the absence of the red light. It evokes the lever press as a CEO, a stimulus change that alters the reinforcing effectiveness—the *value*—of the buzzer sound and evokes the behavior that produces it” (p. 204). But in terms of a discriminative stimulus analysis, the light is the S<sup>D</sup> for the lever press producing the joint events, buzzer and food; in

the absence of the light, lever pressing does not produce these joint events. Thus, the light functions as an S<sup>D</sup>, even in Michael’s terms.

In summary, although we applaud Michael’s analysis of establishing operations, we prefer that the same operation does not also usurp the role of the S<sup>D</sup>. At least in our view, this usurpation is unnecessary and potentially confusing.

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